feature articles

Christmas Among Crevasses: How a Goddard Scientist Spent His Holiday Season

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As the leader of 15 Antarctic field expeditions he has extensive first-hand knowledge of the hazards and challenges of working in the Antarctic environment. Other research has taken him to Greenland and various glaciers throughout the world. During his 28 years at Goddard, he has developed numerous unique applications of remote sensing data for glaciological research including measuring ice velocity and elevation using both visible and radar imagery, monitoring new snowfall on the ice sheet by microwave emissions, and detecting changes in ice-sheet volume by repeat space-borne radar altimetry.

He has testified before Congress and briefed the U.S. Vice President on the issue of ice-sheet stability and served on many scientific commissions and study groups as an expert in glaciology and remote sensing of ice. He has published over 150 scientific papers, numerous review articles and has appeared on television, radio and is often quoted in print media commenting on glaciological impacts of the climate on the world's ice sheets and glaciers.

Following are excerpts from his blog during a recent Antarctic trip. It was first published on Discovery earthlive and is reprinted with their permission. For the complete blog go to ***blogs.discovery.com/discovery_earth_live/***

Greenbelt, Maryland, December 7, 2007 3:30pm

Posted December 13, 2007

Christmas Among Crevasses

Every trip needs a theme…[and Christmas Among Crevasses is] going to be mine this field season. I like it because it touches on two very important aspects of conducting scientific research: **scientists don't always get to choose the time they work**, and **we have to go to where the action is**, even if it may be a dangerous place. Both are true for me this holiday season and I'm inviting you to come along by following this blog.

Today I packed up what I think I'll need from my office: maps (images actually), laptop computer, a notebook and some work I didn't quite finish yet (there always seems to be too much of that). I said goodbye to lots of friends there and received good wishes from all. It seemed odd to be wishing them a Merry Christmas and Happy New Year, but I won't see them again until 2008.

Why? Because I'm preparing for a field trip to Antarctica. It's my 15th Antarctic field trip. I am leading a new project designed to find out what is causing a major part of the West Antarctic ice sheet to become suddenly so active. Satellite-based observations, supported by some airborne measurements have shown that ice flowing into the Amundsen Sea is thinning rapidly (a few meters per year) and accelerating (a few percent per year). The spatial pattern of change suggests that the cause is warm water melting ice more rapidly underneath the floating fringes of the ice sheet. These floating fringes are called *ice shelves* and are hundreds of meters thick.

Why now and what's the danger? The sun is up only six months of the year in Antarctica and we are aiming at mid-summer because we think we'll have the best chance of good weather then. The danger comes from all the crevasses on this ice shelf. The fast motion

of the ice (and I'm talking ripping fast for ice—**10 m/day!**—that's more than **1 ft/hour!**) breaks the ice apart. These crevasses are BIG—tens of meters across and hundreds of meters long. Most are hidden beneath fragile *snow bridges* that can collapse if someone (like me) were to step on one. I don't intend to, but that part of the story will come later.

This weekend it's time to pack the rest of my clothing, say goodbye to wife and cat, and start the journey. By Christmas we hope to be camped on the ice shelf that is fed by the Pine Island Glacier (PIG). We've posted more information about this project on the Pine Island Glacier Ice Shelf Web site *pigiceshelf.nasa.gov*. And I'll let you in on more of the story, too, as the trip unfolds.

McMurdo Station, Antarctica, December 25, 2007

Posted December 25, 2007

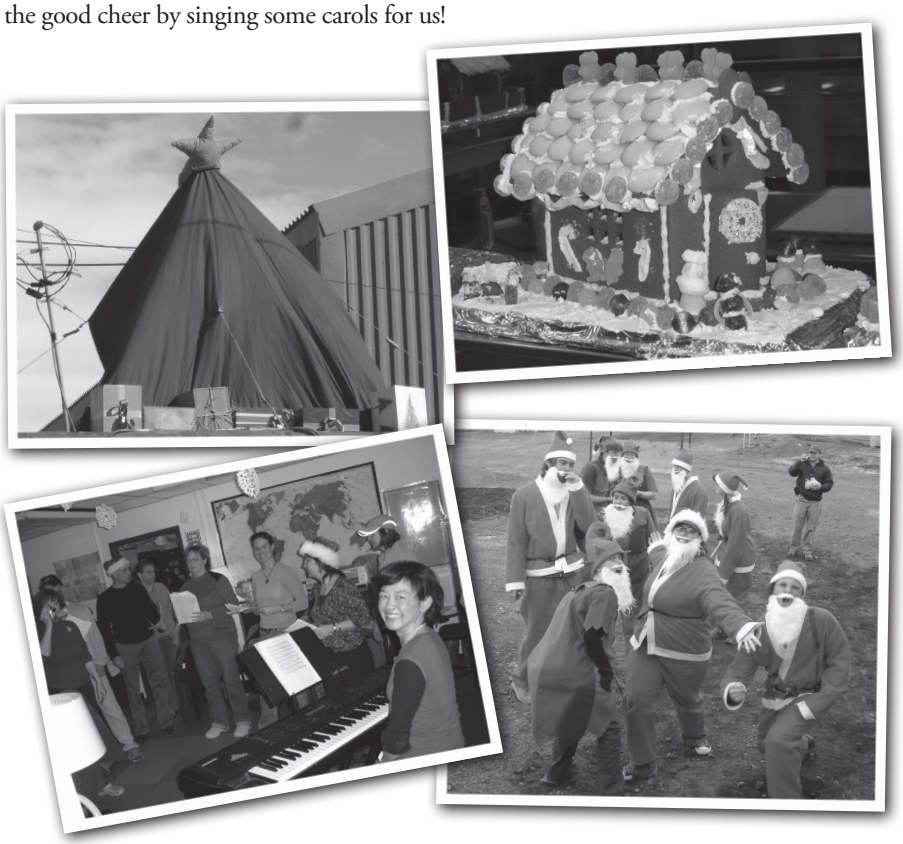
Santa Gets Around

A polar "Ho Ho Ho" to you all. Sunday night was the Christmas party in the "Heavy Shop." Most of the town turned out—many in rather bizarre costumes: a Santa on a skidoo; a 10 ft-tall tissue-paper abominable snowman; and reindeer antlers made from exhaust manifolds were but a few examples. Fancy gingerbread houses were on display in the galley. Decorations appeared on many doors and within many offices.

"Merry Christmas" was definitely the greeting most often given today, and the internet and phone lines were crowded. I called home, too.

I was prepared to be *in the field* on Christmas, but I'm not; nor am I home with family. To be in between leaves me with an odd feeling. Until I get into the field, I cannot make progress toward getting home. It's a funny state of limbo.

My greatest pleasure this season has been singing in the local choir that is composed of volunteers. We had three performances: the Christmas party; a version of Lessons and Carols prior to Midnight Mass at the Chapel; and today (Christmas) in "MacOps," the radio room to broadcast our carols to the field parties. South Pole Station even returned the good cheer by singing some carols for us!



Christmas at McMurdo: A tree made from a tent, a gingerbread house, singers singing carols, and a rather motley looking crew of Santas.

McMurdo Station, Antarctica, December 27, 2007

Posted December 30, 2007

Hanging in McMurdo

I haven't been doing much the past two days. This situation reminds me of a primary requirement of Antarctic field work—*patience*. Usually what demands patience is the infamous Antarctic weather. The concept of *wind chill* is very familiar, but few may know that Paul Siple, at 19 and an Eagle Scout with 60 merit badges at the time, began his illustrious Antarctic career in 1928 by being selected from 800,000 Boy Scouts to accompany Admiral Byrd to Antarctica. Years later he formalized the concept of wind chill and even the term itself with seminal measurements during an Antarctic season recording freezing times of water at various temperatures and wind speeds.

It's an effect you quickly adjust to down here. **If you want to know how many layers of clothes to put on before leaving your tent, listen to the wind and don't worry so much about the temperature.** On a grander scale, wind moves a lot of snow around here. What ultimately stops some of the snow is being jammed into the icy surface of a snow dune, called *sastrugi* (after the Russian for *snow dunes*).

Another thing that blowing snow can stop is field work. Snow moving in the air above the surface, can keep you in your tent for days. It finds its way into your clothes through even the smallest openings, where it melts and threatens to get you wet and COLD. Driven against your skin, it can feel as sharp as sand in a sand storm.

The best remedy for these conditions is patience. Eventually, *even I* will fly out of here, deeper into Antarctica, where the mysteries of sudden and dramatic ice sheet movements wait to be solved. Watch out PIG, I'm still coming!!

Until then, I wait.

McMurdo Station is a bustling little town of about 1,200 people during the summer. Part way-station, part frozen metropolis, it boasts a hard-working population of energetic specialists.

McMurdo Station, Antarctica, December 31, 2007

Posted December 31, 2007

Plan C and then D

I'm anything but ungrateful. The efforts to get a few of the last field projects into the field are admirable. A lot of good ideas have been tossed onto the table both here and at the deep field camp, called West Antarctic Ice Sheet (WAIS)-Divide, where we eventually must go before our final destination.

But as last week finished, the decision to scout out a possible deep-field landing site for the large LC-130 *Hercules* aircraft to cache our cargo near the ice shelf had been scrapped. In its place was a new plan to use the *Herc* to air-drop fuel so that the smaller *Twin Otter* could refuel and thereby move us and our material in small bits the 300 nautical miles between WAIS-Divide and the PIG ice shelf. WAIS Divide is at 79.4 S, 111.2 W and eventually our PIG Shelf camp will be at 75.1 S, 100.1 W. You can go to *Google Earth* to plot these positions and see how far we still have to go.

But back to planning.

There were concerns about the environmental risk of air-dropping approximately 50 fuel drums and whether there were enough parachutes and netting to complete the mission. Fuel drops are subdivided into palettes of 4 drums each, with about 16 in of corrugated cardboard beneath, to absorb the shock of impact, a parachute to slow descent, and secured with heavy webbed netting, to hold everything together.

By this morning, it looked as though an air-drop was possible later this week. That's when Plan D was spawned. Now maybe I'm out of date in the time it has taken me to write this blog, but what I heard this morning was that a second *Twin Otter* was heading for WAIS-Divide today so they could start deploying the two field camps even before the fuel drop, so they will have to either stage some fuel themselves or take some along. Either way, they will not be able to haul as much of our camp and science cargo as quickly, but will be able to start right away.

If weather doesn't disrupt Plan D (leading to Plan E), then our group will pack our socks and undies tonight to leave McMurdo tomorrow, arriving at WAIS-Divide sometime tomorrow evening.

WAIS Divide, Antarctica, January 2, 2008

Posted January 2 2008

On Top of West Antarctica

Yesterday came the call we've wanted since arriving in McMurdo. We were manifested to fly to the WAIS-Divide camp in West Antarctica, our jumping off point for the PIG Shelf and a 1000-mile step in the right direction. Check-in time was 9:00 a.m. for a 10:00 a.m. departure. We eagerly packed and came prepared to get weighed the evening before the flight. We didn't break the scale, so I guess we haven't been overeating too much.

Not long after 10:30 a.m., we were strapped in and heading down the runway. Then we slowed, turned and headed down the runway again. Then we slowed again and headed down the runway even faster. This back-and-forth continued for 10 takeoff runs before we finally were able to get airborne. I'm not sure what the problem was, but we all were glad to be in the air.

Three and one-half noisy hours later, we descended to the snow strip and made a smooth landing at WAIS-Divide where a 3500-meter long ice core is being drilled to recover valuable paleoclimatic records. Tomorrow they take their first "real science" core. Everyone is excited.

We're excited, too. The weather forecast is for gradual improvement. Before dinner we located all 9,000 lbs of our cargo. We'll talk to the *Twin Otter* pilots tomorrow and begin to separate our gear into individual flight loads of about 1900 lbs each. By the time we're done, we will have lifted every pound of the 9,000 a couple of times. I'm getting tired just thinking of it. It's been a long day. I'll try to send a blog tomorrow, but the bandwidth from here is too small to include a picture. Time for bed.

The aerial workhorses of the Antarctic this season: the large LC-130 *Hercules* can haul up to 25,000 lbs and supplies the major stations and large field camps; the *Twin Otter* does the precision work and is going to get us onto the PIG ice shelf carrying 2000-lbs loads.

PIG Shelf, Antarctica, January 3, 2008

Posted January 3, 2008

Success!!

On the ice shelf at last!! We made it to a place no one has ever been, a place many colleagues thought we could never land, a place where we believe drastic changes in the ice sheet are being triggered, a place I have been dreaming of getting to through more than two years of planning.

Whoa, my feet didn't sink into snow at all. The surface was really, really hard. That's why the landing had been a little rough. It will make for safer travel. Bridges across crevasses will be firmer, able to hold more weight. But my excitement is getting me ahead of the story.

Our reconnaissance flight was tacked onto the end of the final put-in flight for the group studying the neighboring Thwaites Glacier. After that, we had to add fuel from palettes of fuel drums the Air National Guard had parachuted to the surface just the day before. Our mission was still 100 nautical mi away.

That final leg of our journey became very scenic as we neared the PIG ice shelf. A multitude of crevasse fields beneath us told of rapidly moving ice. We could even see blue water beyond the shore peppered with thin sea ice and a few larger, thick tabular icebergs. This is a very active place where the ice sheet races to the Antarctic coast and reenters the world's ocean.

A palette being prepared for air-drop. Imagine the pile of boxes replaced with 4 drums of fuel, the webbed netting strapped down tightly and a small parachute pack attached to the top and you have what is being prepared for us.

The PIG shelf began to appear on the horizon. First as bright areas of crevasses, miles across. Single crevasses were monsters 50 ft across and sometimes more than a mile long. Holes in snow bridges let us look straight down into the icy voids, often with draperies of snow hanging tens of feet into the blackness.

I began to see features out my window that I recognized from the images I knew so well. And then, there it was!!! The "sweet spot" of the ice shelf. No crevasses! We began a careful aerial reconnaissance that took us back and forth, first at 1500 feet altitude, then 1000 feet, finally a very slow pass at 500 feet. Looking at different angles, every set of eyes in the plane was straining to see even the slightest hint of hidden crevasses.

There were none to be seen so the next step was to "ski drag." This is when the airplane flies along the surface, using its own weight to press downward on the snow, but flying fast enough to remain airborne. The pilot then circled around to look for bridges that may have collapsed along the drag line. There weren't any, but the tracks were so slight, he wanted to repeat the procedure with more pressure. Rough again, but no danger spotted. We circled to land.

This was exciting. There was a lot of emotion mixed with the excitement. A *Twin Otter* can stop very quickly and in less than 400 ft and a couple of seconds, we came to rest on the ice shelf. It WAS possible!

We helped the pilots mark their runway with black garbage bags we filled with snow. With a shovel in hand, I couldn't resist digging a little deeper. I discovered a hard layer of solid ice about an inch below the hard crust. Below that, there were more icy layers with snow the consistency of sugar.

PIG Shelf, Antarctica, January 3, 2008

Posted January 5, 2008

Oh No!

I couldn't believe my ears. The pilot's voice coming through my headset started with "Bob, we have some bad news"… our landing site was too hard, too rough and too short. This translated into limiting take-off weights. So, although they would be able to get us onto the ice shelf with our camping gear and scientific equipment, it would be very hard to pull us out without taking far too many loads.

They asked what I wanted to do—a hard question to be hit with an hour after the elation of a successful landing. I felt like the entire program we were finally going to be able to do had just been gutted. The second *Twin Otter* supporting us was already full of our first cargo load and was at the ice shelf. They were looking for an alternate spot and having no luck. Could I advise them where to look? No. I only knew of one spot like the one we had just visited. They had seen a nice spot off the ice shelf. Was that OK? No. The whole point was to measure water properties and speed of the ice shelf.

Meetings between me and the pilots and a teleconference with science program managers in McMurdo were already arranged by the time we landed back at WAIS-Divide. A near-immediate redesign of my program was being requested. It was not a pleasant moment.

We had actually landed on the ice shelf. We had finally overcome that long-standing hurdle and I was racing along thinking how great the next week was going to be as we began to actually make measurements….and…it had been snatched away by this unfortunate decision. Before long, I heard from McMurdo the unequivocal decision "you will not land on the ice shelf again this season."

I met with the rest of our field team, presented the situation and we discussed what could be salvaged. So much required us to be on the ice shelf. The only item that could be useful off the ice shelf was the automatic weather station. We examined

imagery to find the best candidate locations and are hoping to build and deploy the station at one of these sites starting tomorrow.

Tonight I am an emotional wreck. The range of emotions hit some enormous highs along with some abysmally low lows.

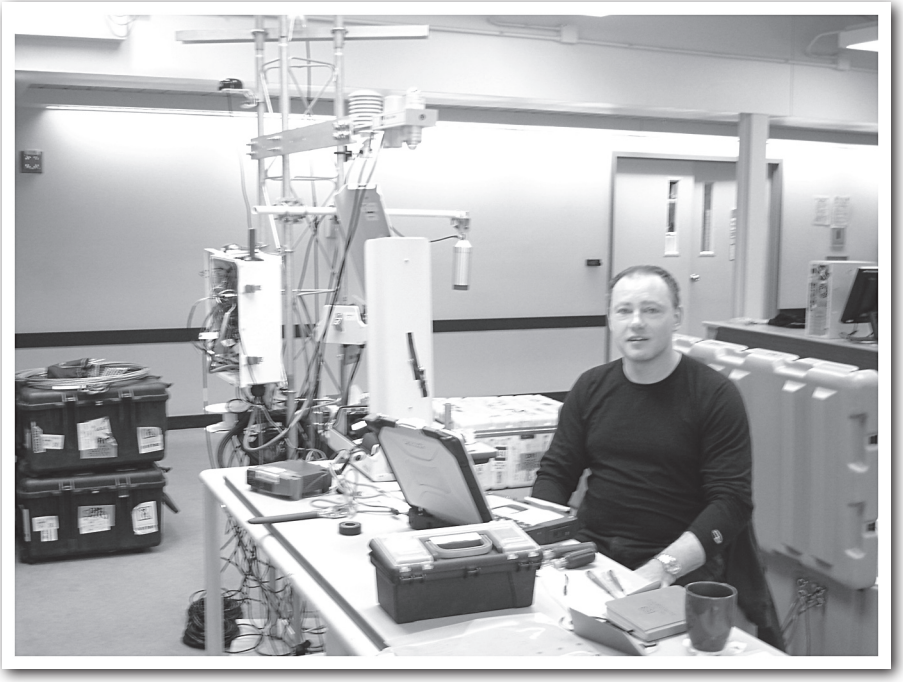
McMurdo Station, Antarctica, January 11, 2008

Posted January 11, 2008

Making the Best of Things

I'm still smarting from the emotional crash of having actually landed on the ice shelf, only to be told the *Otters* would not land there again (this season). Assuaging the pain is the knowledge that at least now we have a field team deployed to a site adjacent to the ice shelf where the snow is softer, the winds apparently milder and the view spectacular.

The three team members are putting up the automatic weather station. Antarctic research certainly has gone "high-tech." I still remember the days of needing to take *sun shots* to determine our location, navigation was done with compass and distances were measured by steel tape. Hey, that wasn't so long ago (i.e., I'm not THAT old!); I'm talking about 1982, my first Antarctic season.



My colleague **David Holland** testing his "baby," the automatic weather station. He had to set up a compressed version so it fit in the lab, but it all checked out. In the field the tower will be 14 ft tall and be rigged to support winds of at least 150 mph.

Our group is trying out a combination of 10 deep-cycle batteries, two large solar panels and two wind generators, to maintain sufficient power through the winter for our weather station, but others are using it for other instruments like Global Positioning System (GPS) units. Our installation will be particularly useful, because we include two web cams that will take a daily picture that we not only add to the weather information, but will allow us to see if the snow or wind or ice are making life difficult for the instruments and power components.

I stayed back at WAIS-Divide because a fourth person would make our camp heavy enough that an extra flight would have been necessary to get us deployed. I also felt that there were other ways I could be more useful to the project.

What I was able to contribute was a new use for the two winter-over GPS units we have here. They are still just sitting idle on the cargo line and an unused scientific in-

strument is a terrible thing (at least to a scientist). The PIG ice shelf is fed by the very fast Pine Island Glacier and this glacier has a number of tributaries that feed it. These tributaries flow at speeds that gradually decrease upstream, improving the chances for finding a crevasse-free spot. One tributary lies within 20 mi of the weather station site and the next closest is only 40 mi farther. My plan is to be flown upstream along these tributaries from their junctions with the main flow of the glacier, where crevasses are rampant, until a crevasse-free area allows the Otter to try a landing. If it can land, I will be left with the GPS equipment and a lucky WAIS-Divide staff person to set up the instruments while the *Otter* hops over to the weather station camp. There they will pick up those three folks and then return to me. Once we are done, we will all return to WAIS-Divide.

And so it goes. Plans change and change again. Good Antarctic field scientists never accept just giving up and going home without squeezing every possible productive use of the equipment and time we have here.

McMurdo Station, Antarctica, January 13, 2008

Posted January 13, 2008

CNX

There is a white, dry-erase board just inside the galley door where the current information on flights is posted. Each evening, McMurdo usually passes out the flight schedule for the following day. A flight to WAIS usually is included, but early the next morning the dreaded "CNX" is added to the board. That's the code for a cancelled flight and it has happened almost daily this past week, both for *Hercs* bringing camp supplies out and returning some people whose work out here is done, and for *Twin Otters*, the airplane we still need to deploy our GPS stations. First our weather was poor, then McMurdo received a windy, heavy snowfall that shut down the runway there.

The only flight that arrived this week was a *Twin Otter* that had been at the South Pole. We were glad to receive it. The three members of my team were still out at a remote camp waiting to be picked up. Their work installing the automatic weather station was finished a day earlier and it is operating normally. They were far from uncomfortable. While WAIS was being hit with 20-kt winds, drifting snow and wind chills around -30° C, they were in the sunshine with light winds and temperatures near or even ABOVE freezing. They saw their situation differently, however, claiming that because their two bottles of wine were now empty, it was time to be pulled out.

I was able to make dual-use of the pull-out flight by loading the *Otter* at WAIS with the equipment for a GPS station. While that was going on, Ben, my super-strong field hand, and I began setting up the GPS station. It seems silly—the GPS unit itself weighs all of 3 lbs, but the power system required to get the GPS to operate through the long, cold, dark Antarctic winter weighs about 1000 lbs. Most of that is batteries—ten big heavy ones—but the system also includes two solar panels to recharge batteries during the summer, and two wind generators to help the batteries get through the dark winter. Add steel guy lines designed to hold it all together in 150 mph winds, and there is a lot of work to install the system.

I had prefabricated a lot of the pieces to minimize the installation time, but it still took two hours—the final 30 minutes after the *Otter* had returned with the three other happy campers. The pilot was getting very antsy during those final 30 minutes because the report from WAIS was that the weather was getting worse. It improved just enough during our two-hour flight home that we had no trouble landing at WAIS.

That was Thursday. Today is Sunday and nothing of note has happened in between. We had hoped to have that *Otter* for six more hours to install our second, and last, GPS, but it was called back to McMurdo the very next morning. A person here hurt

her shoulder and the medic wanted her to get an X-ray as soon as possible. She had already waited four days as "CNX" appeared on the flight board day after day.

The last two days another *Twin Otter* coming from Patriot Hills has been CNX'd. After yesterday's cancellation, I held a small team meeting to see how people felt about calling a halt to our season. Some will return to McMurdo but David and I remain determined to get the second GPS installed at least along a tributary of the PIG. We'll stay here until we are forced to leave. We've come too far not to leave the GPS where we can get some valuable information on ice motion of the glacier. I've had to start adjusting my schedule back home. **Antarctic science rarely runs on schedule.**

PIG GPS Site, Antarctica, January 13, 2008

Posted January 13, 2008

Sweeeeet!

At Last!! Today was a good field day. A *Twin Otter* was able to make it to WAIS-Divide in the afternoon, took us to our second and final site to deploy a wintering over GPS…a gorgeous blue sky, NO WIND, and just to spice up the spot, monstrously large crevasses nearby. Two of our team were supposed to be heading back to McMurdo this same day, but the flight was cancelled, so all four of us were able to work on this together. The conversation ran pretty free over many topics with a lot of kidding and laughing. We all enjoyed what we were doing, who we were doing it with, and where we were doing it. It was absolutely great!

For all the frustrations of this season, we ended this day with a wonderful sense of accomplishment. The *Twin Otter* crew allowed us the luxury of a few final minutes to get "team pictures" at the site before we left. We didn't return to WAIS camp until midnight, but we were still pumped up and stayed up for another couple of hours feeding our faces and talking about how beautiful the day was.

Having finished this work, we all can now queue up for the next *Herc* for McMurdo. **Each field season, I rediscover the depth of the bond that is generated by the shared experience of working together in an environment that presents a variety of challenges that must be overcome…we will be life-long friends.**

When the season ends, it often ends in a flurry of activity. This may be true again. In anticipation of that *Herc* arriving today (the weather is good now, but forecast to "go down"), we have to get our personal gear together relatively quickly. And once we reach McMurdo, David and I will have to keep hopping to return all our camp equipment, radios, skidoo parts, etc. before showing up for tomorrow's flight off The Ice to New Zealand. Then another quick overnight before the commercial flight home. The transition can be quite jarring.

Part of me wants to sit back and savor our accomplishments. We've responded to the massive disappointment of having landed on the ice shelf only to be told we couldn't return there. We've deployed our instrumentation as close to the ice shelf as is safe considering its bounding crevasse fields, and we will be able to "watch" it in three spots throughout the winter and until we return next year with the data that will be transmitted back from our instruments. We talked about it last night and everyone is proud of how we met the numerous challenges that we faced the past few weeks.

WAIS-Divide, Antarctica, January 14, 2008

Posted January 15, 2008

Fury

I'm prepared to leave Antarctica now. But today I was reminded that Antarctica makes the rules down here and the fact is that Antarctica is not ready to let go of me yet.

The morning sun was high and shone brightly from a crisp blue sky. Not much to catch up on—I only had some last minute packing to do and for that I was waiting

until notified that the *Herc* had actually left McMurdo. It's a common superstition with Antarctic field hands that taking your tent down before the plane is in sight is bad luck.

Much to my surprise, just before lunch, Elizabeth, the camp supervisor came into the galley and announced that *Skier 61* (the name of today's *Herc* mission to WAIS-Divide) was cancelled. Cancelled?! She said the forecast was for increasing winds and decreasing visibility beginning in the next two hours. It's sometimes hard to believe these forecasts; in season's past, they have been wrong at least as often as right. Well maybe the forecast models are getting better because almost on cue, the winds began to build. By 3:30 pm, when the *Herc* had been scheduled to arrive, visibility was "nil/nil," meaning no horizon was visible and there was no surface definition.

When this happens in calm conditions, it is called a *white out*. This time the reason is blowing snow. Snow is blowing through camp in horizontal sheets, nearly hiding all buildings, vehicles and cargo in a thick haze of white. The only sounds are the howling wind and the sharp cracking of the flags on the many bamboo poles that mark where items are located.

Inside, the cook is playing music as he usually does (he has about ten million songs on his laptop) and there are some conversations at the tables, but the outside sounds penetrate the soft walls and occasionally drown out the music. To be sure, the galley is warmer than outside, but the wind sucks heat from everything and even cranking up the stove doesn't prevent the inside temperature from being colder than it has been the past week.

Most of the people in camp are involved in the ice-core drilling project based here and they are still working three shifts a day so they come and go. For those of us just waiting for the *Herc*, many diversions are available—*Cribbage* and *Scrabble* are among the most popular. There are many laptops open and people share their pictures and music. The slapping flags tell us the weather is not changing.

After dinner, Elizabeth shares with us the forecast that winds will intensify, gusting to 40 kts through the night lasting to at least 5 a.m. "Be careful," is her message.

Many people still sleep in tents at the edge of camp. There is usually some object (a flag, tent or building) every 30 ft to prevent people becoming disoriented. Walking outside requires focusing on where you are going and remembering that each step you take is crucial. New drifts can grow quickly. It's not dangerous as long as you remember where you are.

The movie playing in the Rec hut doesn't interest me and I decide to go to bed before 10 p.m. I have to shovel a small drift away to get into the Jamesway hut I'm sleeping in. The stove is working but the interior is still cold. The other door has been blown open and a drift is growing inside the hut. I shovel that snow back outside. The door frame has twisted so the door latch doesn't hold. I shove the fire extinguisher and an unused heater against the door to hold it. I breathe a long sigh of welcome relief as I slide into my sleeping bag and pull it up over my head. I will be very warm soon.

I'm glad that as storms go, this is pretty mild. Storms with winds of 100 kts, even 200 kts are not unusual during winter. I wonder, but not too long, how they must feel and sound as I drift to sleep.

A Field Season's Final Thoughts

Posted January 17, 2008

On the Herc Flying Back to McMurdo Station

Today the weather cleared at both WAIS-Divide and McMurdo and, much to the delight of people at McMurdo waiting to go to WAIS camp and of people at WAIS waiting to go to McMurdo, a *Herc* managed to make the trip. Coming from

McMurdo were a group of inspectors who needed to check out the construction of the ice coring facility, a few replacement camp people, and Charlie Bentley, a much renowned glaciologist whose first season in West Antarctica was 50, that's right 50, years ago during the International Geophysical Year. Going to McMurdo were our group and a few others who had been stranded at WAIS many days longer than we.

This flight marks the end of my field season. We have a few tasks to do in McMurdo: returning keys and equipment to various suppliers, etc., however, the steps are very routine. If I complete them quickly enough, I will be able to get a seat on the flight to Christchurch, New Zealand tomorrow evening. It's a flight I'm GOING to make. If airline connections are good, I should be home to see my wife about 30 hrs after leaving Antarctica.

I leave you with a final picture of me standing on the PIG ice shelf. This was one of our objectives we met. Unfortunately, we were not able to set up our camp there, but we placed our instruments in valuable locations and have learned a great deal about the area that will feed directly into our planning for next season's work.

Robert Bindschadler standing on the Pine Island Glacier ice shelf with the *Twin Otter* aircraft that landed there in the background. This remains the only landing ever on this ice shelf and confirmed that an uncrevassed area large enough for a safe landing was possible.

I've written about the challenges we've faced (and overcome), the frustrations of weather and logistics, and the science we've done (and why). **What my mind turns to now is the privilege I feel to have the opportunity to work here.** I can't think of a better place to do Earth science research. Each season I have engaged in has instilled in me a sense of wonder for the natural world, an appreciation for the opportunity to work here and undying gratitude for the many, many people who work to make my research possible.

Antarctica is a magnificent continent. Its majestic beauty is beyond description, its scale is unimaginable, and its intensity like no other place I've been. I've flown for miles and miles over seemingly unending emptiness, but I know that beneath me lay dynamic features so huge that the eye cannot take them in..

Nature speaks more loudly in Antarctica than anywhere else I've experienced. Her storms force humans to submit to her weather. You come to be grateful for the windows of milder weather when you can do your research because when she roars, you must wait. She rules—and we are, and will probably always be, only visitors.

I work in a relatively small field of research. There are maybe two dozen people in the U.S. and maybe three times that worldwide who do the type of work that I do—

and half of them don't include field work in their research portfolio. It is rewarding research for many reasons. I can think of nothing so exciting about science as making new discoveries. The new urgency of my research brought by the rapid acceleration of changes we observe adds pressure, but also an increased sense of importance to what I'm doing in Antarctica.

Finally, there is a very strong sense of gratitude for all the support that surrounds field science like mine. From the field camp workers who will do whatever you ask of them, to the McMurdo support of 1000 plus, to the citizens that support the work with their tax dollars, I never leave the field without being reminded that I do not work alone.

From here, I return to my office and laboratory, to begin analyzing the data from this season and planning the next season's work. David Holland and I will meet with our other co-investigators at the end of February. Not long after that, I will be discussing with the National Science Foundation the field support we will need for the next season. If DiscoveryEarthLive wishes, I will continue to report on our progress.

Until we "meet" again. ■

KUDOS

EOS Scientists Chosen as 2008 AGU Fellows

Each year, the American Geophysical Union (AGU) recognizes individuals who have made outstanding contributions to the advancement of the geophysical sciences, to the service of the community, and to the public's understanding. The following members of the Earth Observing System scientific community have the distinction of being named Fellows for 2008. Not more than 0.1% of AGU members are given this honor each year.

Robert Bidigare, University of Hawaii
David Chapman, University of Utah
Dudley Chelton, Jr., Oregon State University
Elfaith Eltahir, MIT, Cambridge
Jeffrey Kiehl, National Center for Atmospheric Research, Boulder
James Kirchner, University of California, Berkeley
Charles McClain, NASA Goddard Space Flight Center
Michael McCormick, Hampton University, Hampton
Robert Nerem, University of Colorado, Boulder
Venkatachalam Ramaswamy, NOAA GFDL, Princeton University
John Rundle, University of California, Davis
Jagadish Shukla, George Mason University

The Earth Observer staff on behalf of the entire scientific community congratulates these individuals on this outstanding accomplishment.